Harris Corporation v. Huawei, et al – Case No. 2:18-cv-439
Plaintiff's Disclosure of Asserted Claims and Infringement Contentions (Pat. L.R. 3-1 & 3-2)
Exhibit B – U.S. Patent No. 6,958,986 ('986) – Claims 1, 5-6, 9, 17, 21-22, 25

Harris Corporation expressly reserves the right to supplement or modify these Disclosures as appropriate upon receipt of further information and discovery. The Huawei '986 Patent Accused Products (as that term is defined and the corresponding devices are identified in Harris's P.R. 3-1 and P.R. 3-2 disclosures cover pleading) infringe at least the following claims. References to instrumentalities in this chart are exemplary only and should not be construed as limiting the scope of any claim of the '986 patent. The Huawei '986 Patent Accused Products satisfy each claim element below literally. The Huawei '986 Patent Accused Products also satisfy claim elements under the Doctrine of Equivalents, including without limitation where specifically identified below, because they include and perform substantially similar functionality.

All ***bolded italicized*** emphasis added unless noted otherwise.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
1. A wireless communication network comprising:	The Huawei '986 Patent Accused Products infringe this claim. The Huawei '986 Patent Accused Products incorporate a wireless communication network. The Huawei '986 Patent Accused Products include the Huawei Wi-Fi Products. Huawei represents that certain of its products (the Huawei Wi-Fi Products) comply with and communicate according to IEEE 802.11 Wi-Fi standards, including the base 802.11 standard, the IEEE 802.11ac standard, and/or the 802.11s standard. *See, e.g.*, Huawei, Huawei Enterprise AP Series 802.11ac Brochure, at Table 5-1 ("Specifications of Huawei 802.11ac APs"); Huawei, Agile Distributed Wi-Fi Solution, Datasheet, at 2 ("The agile distributed Wi-Fi solution is composed of the central AP (AD9430DN-24 or AD9430DN-12) and remote unit (R250D-E, R250D, R240D, or R230D)."), 10 ("Compliance with IEEE 802.11a/b/g/n/ac"); *see also* Huawei WLAN Products: Indoor Access Points, Outdoor Access Points, and Scenario-specific Product Series webpages, *available at* https://e.huawei.com/us/products/enterprise-networking/wlan (last accessed April 1, 2019). The IEEE 802.11 standards, including the IEEE 802.11s and IEEE 802.1ac standards, describe and require a wireless communications network comprising wireless mobile nodes and wireless communication links between the nodes. For example, and without limitation:

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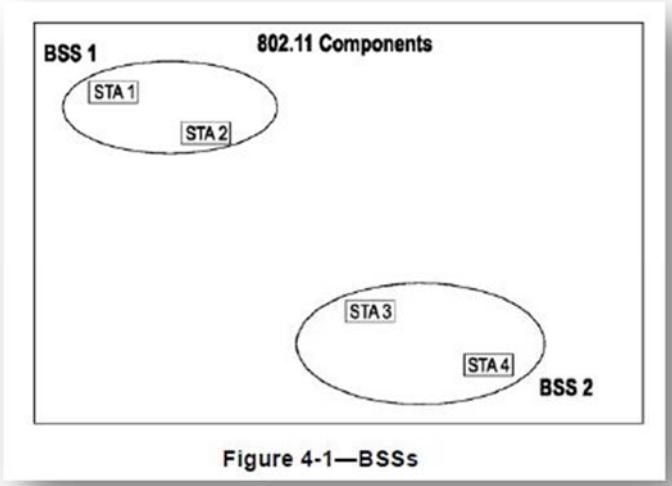
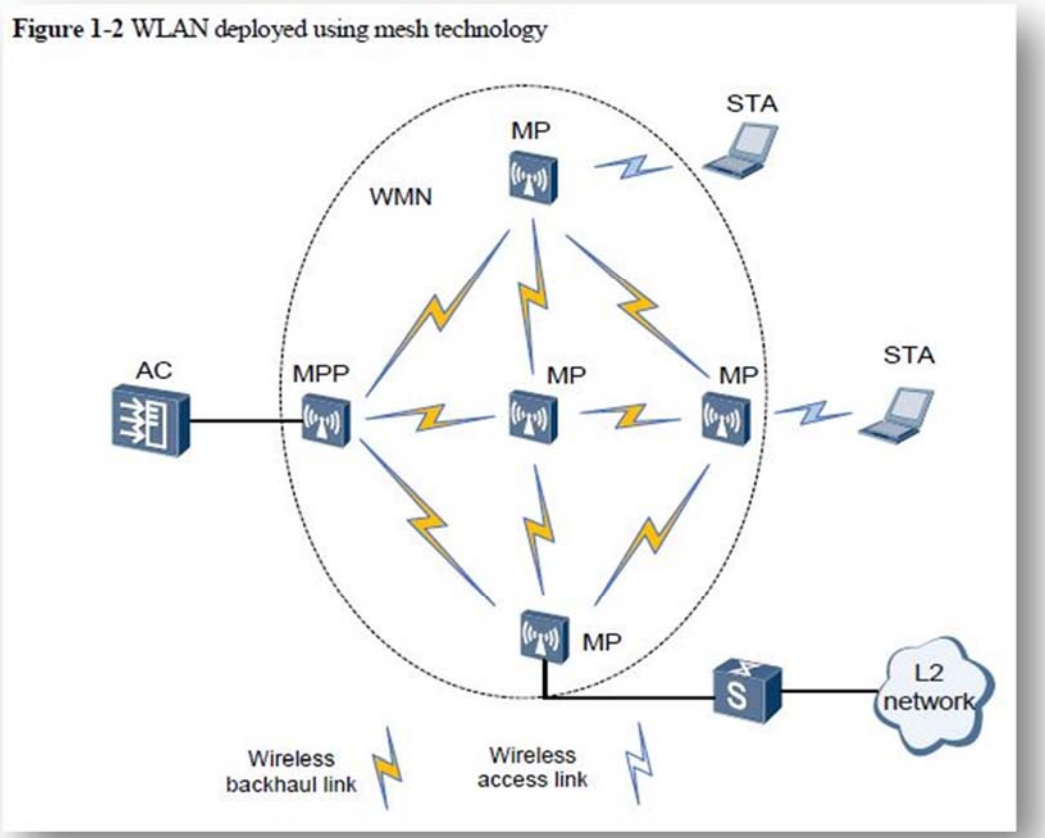
	In the design of wired LANs it is implicitly assumed that an address is equivalent to a physical location. In wireless networks, this is not always the case. ***In IEEE Std 802.11, the addressable unit is a station (STA)***. The term implies no more than the origin or/and destination of a message. Physical and operational characteristics are defined by modifiers that are placed in front of the term STA. For example, in the case of location and mobility, the addressable units are the fixed STA, the portable STA, and the ***mobile STA***. The STA is a message destination, but not (in general) a fixed location. IEEE Standard for Local and Metropolitan Area Networks – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, IEEE Computer Society, IEEE Std 802.11-2012, at p. 44. The IEEE 802.11 architecture consists of several components that interact to provide a WLAN that supports STA mobility transparently to upper layers. The basic service set (BSS) is the basic building block of an IEEE 802.11 LAN. Figure 4-1 shows two BSSs, each of which has two ***STAs that are members of the BSS*** IEEE Std 802.11-2012, at p. 45.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	 Figure 4-1—BSSs IEEE Std 802.11-2012, at p. 46, Figure 4-1. Because this type of IEEE 802.11 LAN is often formed without preplanning, for only as long as the LAN is needed, this type of operation is often referred to as an ad hoc network. IEEE Std 802.11-2012, at p. 46. The VHT PHY provides support for 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous channel widths and support for 80+80 MHz noncontiguous channel width. IEEE Standard for Local and Metropolitan Area Networks – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, Amendment 4: Enhancements for Very High

'986 PATENT CLAIM 1	**INFRINGEMENT BY HUAWEI CORPORATION**
	Throughput for Operation in Bands below 6 GHz, IEEE Computer Society, IEEE Std 802.11ac-2013, at p. 214 The services provided to the MAC by the VHT PHY consist of the following protocol functions: a) A function that defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs. b) A function that defines the characteristics and method of ***transmitting and receiving data through a wireless medium between two or more STAs***. Depending on the PPDU format, these STAs support a mixture of VHT: Clause 20 and Clause 18 PHYs. IEEE Std 802.11ac-2013, at p. 215. Mesh point (MP): a mesh-capable node that uses IEEE 802.11 MAC and physical layer protocols for wireless communication. This node supports automatic topology discovery, automatic route discovery, and data packet forwarding. Huawei, Mesh Technology White Paper, Issue 01, May 10, 2013, at 3.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	 Huawei, Mesh Technology White Paper, Issue 01, May 10, 2013, at 4, Figure 1-2.

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	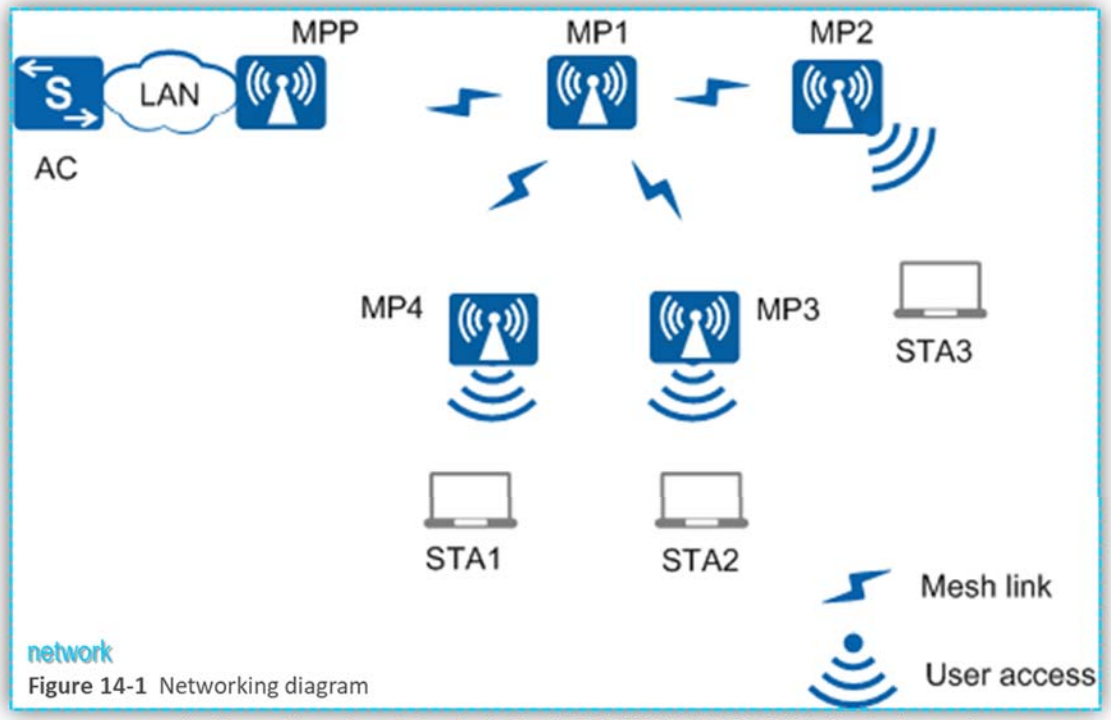 *http://support.huawei.com/enterprise/en/doc/EDOC1000141952/358c72bf/understanding-mesh* Huawei, S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at 1, Figure 14-1 (last accessed April 2, 2019).

'986 PATENT CLAIM 1	**INFRINGEMENT BY HUAWEI CORPORATION**
[a] a plurality of mobile nodes each comprising a wireless transceiver and a controller for controlling said wireless transceiver, said controller also for	The IEEE 802.11 standards, including the IEEE 802.1ac standard, describe and require a wireless communication network comprising a wireless transceiver and a controller for controlling said wireless transceiver. *See* above. For example, and without limitation: Clause 22 specifies the ***PHY*** entity for a very high throughput (VHT) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 22, a VHT STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory PHY specifications defined in Clause 20. The VHT PHY is based on the HT PHY defined in Clause 20, which in turn is based on the OFDM PHY defined in Clause 18. The VHT PHY extends the maximum number of space-time streams supported to eight and provides support for downlink multi-user (MU) transmissions. A downlink MU transmission supports up to four users with IEEE Std 802.11ac-2013, at p. 214. The services provided to the ***MAC*** by the VHT PHY consist of the following protocol functions: a) A function that defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs. b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of VHT: Clause 20 and Clause 18 PHYs. IEEE Std 802.11ac-2013, at p. 215.

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	The MAC functional description is presented in this clause. The architecture of the MAC sublayer, including the distributed coordination function (DCF), the point coordination function (PCF), the hybrid coordination function (HCF), the mesh coordination function (MCF), and their coexistence in an IEEE 802.11 LAN are introduced in 9.2. These functions are expanded on in 9.3 (DCF), 9.4 (PCF), 9.19 (HCF), and 9.20 (MCF). IEEE Std 802.11-2012, at p. 818. A WMN saves cables required between mesh nodes while providing path redundancy and rerouting functions as a distributed network. When a new AP is added to a WMN, the AP can automatically connect to the WMN and determine the optimal multi-hop transmission path after being powered on. When a new AP is moved from a WMN, the WMN can automatically discover the topology change and adjust communication routes to obtain the optimal transmission path Huawei, Mesh Technology White Paper, Issue 01, May 10, 2013, at 2. "Mesh point (MP): a mesh-capable node that uses IEEE 802.11 MAC and physical layer protocols for wireless communication. This node supports automatic topology discovery, automatic route discovery, and data packet forwarding." Huawei, Mesh Technology White Paper, Issue 01, May 10, 2013, at 3. A WMN includes the following devices: Mesh point (MP): a mesh-capable node that uses IEEE 802.11 MAC and physical layer protocols for wireless communication. This node supports automatic topology discovery, automatic route discovery, and data packet forwarding. MPs can provide both mesh service and user access service.

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	Mesh point portal (MPP): an MP that connects to a WMN or another type of network. This node has the portal function and enables mesh nodes to communicate with external networks. Huawei, Configuration Guide – WLAN-AC, at 739.
[b] scheduling a respective semi-permanent time slot to establish a communication link with neighboring mobile nodes for transmitting data therebetween, the data having different priority levels,	The Huawei Wi-Fi Products further schedule a respective semi-permanent time slot to establish a communication link with neighboring mobile nodes for transmitting data therebetween, the data having different priority levels. For example, and without limitation, the IEEE 802.11 standards describe and require, and Huawei has implemented, HCF and MCF functions, each of which coordinates scheduling of prioritized data transmissions with neighboring nodes in time slots. These functions schedule some of those time slots as reserved time slots, as is described below: **contention-free (CF) pollable:** A station (STA) that is able to respond to a CF poll with a data frame if such a frame is queued and able to be generated. IEEE Std 802.11-2012, at p. 9. **hybrid coordination function (HCF):** A coordination function that combines and enhances aspects of the contention-based and contention-free access methods to provide ***quality-of-service (QoS) stations (STAs) with prioritized and parameterized QoS access to the wireless medium*** (WM), while continuing to support non-QoS STAs for best-effort transfer. The HCF includes the functionality provided by both enhanced distributed channel access (EDCA) and HCF controlled channel access (HCCA). The HCF is compatible with the distributed coordination function (DCF) and the point coordination function (PCF). It supports a uniform set of frame formats and exchange sequences that STAs might use during both the contention period (CP) and the contention-free period (CFP).

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	IEEE Std 802.11-2012, at p. 12. **hybrid coordinator (HC):** A type of coordinator, defined as part of the quality-of-service (QoS) facility, that implements the frame exchange sequences and medium access control (MAC) service data unit (MSDU) handling rules defined by the hybrid coordination function (HCF). The HC operates during both the contention period (CP) and contention-free period (CFP). The HC ***performs bandwidth management including the allocation of transmission opportunities (TXOPs) to QoS stations*** (STAs). The HC is collocated with a QoS access point (AP). IEEE Std 802.11-2012, at p. 12. **hybrid coordination function (HCF) controlled channel access (HCCA):** The channel access mechanism utilized by the hybrid coordinator (HC) to ***coordinate contention-free media use by quality-of-service (QoS) stations*** (STAs) for downlink individually addressed, uplink, and direct-link transmissions. IEEE Std 802.11-2012, at p. 12. **mesh coordination function (MCF):** A coordination function that combines aspects of the contention based and scheduled access methods. The MCF includes the functionality provided by both enhanced distributed channel access (EDCA) and MCF controlled channel access (MCCA). **mesh coordination function (MCF) controlled channel access (MCCA):** A coordination function for the mesh basic service set (MBSS). **mesh coordination function (MCF) controlled channel access opportunity (MCCAOP):** A period of time ***scheduled for frame transmissions between mesh stations (STAs) using MCF controlled channel access*** (MCCA).

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	IEEE Std 802.11-2012, at p. 58. ***QoS traffic capability*** procedures enable the QoS STA to indicate that it is capable of transmitting traffic belonging to the corresponding ***user priority (UP)*** from applications that require generation of such traffic IEEE Std 802.11-2012, at p. 59. The first mechanism, designated the enhanced distributed channel access (EDCA), delivers traffic based on differentiating user priorities (UPs). This differentiation is achieved by varying the following for different UP values: — Amount of time a STA senses the channel to be idle before backoff or transmission, or — The length of the contention window to be used for the backoff, or — The duration a STA may transmit after it acquires the channel. These transmissions may also be subject to certain channel access restrictions in the form of admission control. Details of this mechanism are provided in 9.19.2 IEEE Std 802.11-2012, at p. 51-52. The second mechanism, designated the hybrid coordination function (HCF) ***controlled channel access (HCCA), allows for the reservation of transmission opportunities (TXOPs)*** with the hybrid coordinator (HC). A STA based on its requirements requests the HC for TXOPs, both for its own transmissions as well as for transmissions from the AP to itself.16 The request is initiated by the station management entity (SME) of the STA. The HC, which is collocated at the AP, either accepts or rejects the request based on an admission control policy. If the request is accepted, the HC schedules TXOPs for

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	both STAs (both the AP and the non-AP STA). For transmissions from the non-AP STA, the HC polls the STA based on the parameters supplied by the STA at the time of its request. For transmissions to the STA, the AP directly obtains TXOPs from the collocated HC and delivers the queued frames to the STA, again based on the parameters supplied by the STA. Details of the mechanism are provided in 9.19.3 and 10.4. This mechanism may be used for applications such as voice and video, which may need periodic service from the HC. If the application constraints dictate the use of this mechanism, the application initiates this mechanism by using the management service primitives. IEEE Std 802.11-2012, at p. 52. **4.3.7 QoS BSS: The QoS network** The IEEE 802.11 QoS facility provides MAC enhancements to support LAN applications with QoS requirements. The QoS enhancements are available to QoS STAs associated with a QoS access point in a QoS BSS. A subset of the QoS enhancements is available for use between STAs that are members of the same QoS IBSS. Similarly, a subset of the QoS enhancements is available for use between neighbor peer mesh STAs. A mesh BSS is one type of QoS BSS and it is described in 4.3.15. IEEE Std 802.11-2012, at p. 51. Within a mesh BSS, STAs utilize the mesh coordination function (MCF) to access the channel. ***MCF is based on the core QoS facilities specified in 4.3.7***, and a mesh BSS is categorized as one type of QoS BSS. MCF is described in 9.20. IEEE Std 802.11-2012, at p. 62.

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A representation of the MAC architecture is shown in Figure 9-1 in which the PCF and HCF services are provided using the services of the DCF. Note that in a non-QoS STA, HCF is not present. In a QoS STA implementation, both DCF and HCF are present. PCF is optional in all STAs.

Due to the distributed nature of the MBSS, only the MCF is present in a mesh STA.

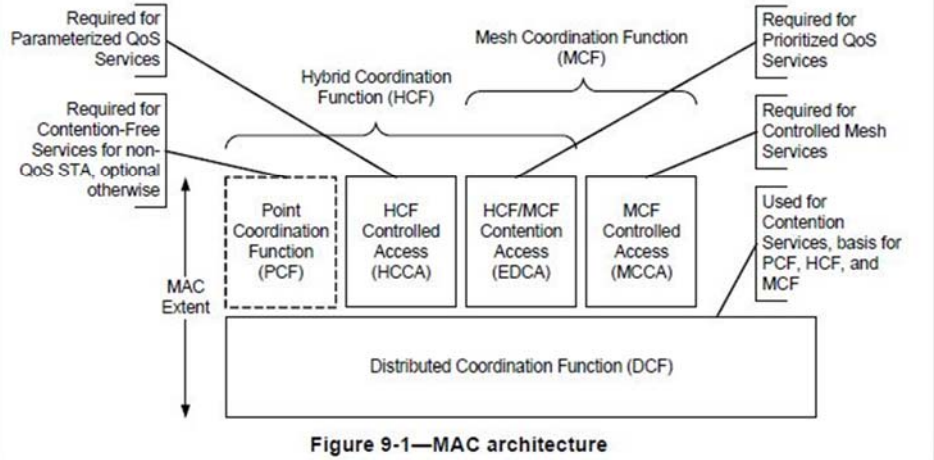

Figure 9-1—MAC architecture

IEEE Std 802.11-2012, at p. 818.

> The QoS facility includes an additional coordination function called *HCF* that is only usable in QoS network configurations. The HCF shall be implemented in all QoS STAs except mesh STAs. Instead, mesh STAs implement the MCF. The HCF combines functions from the DCF and PCF with some enhanced, QoS-specific mechanisms and frame subtypes to allow a uniform set of frame exchange sequences to be used for QoS data transfers during both the CP and CFP. The HCF uses both a contention-based

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	channel access method, called the *enhanced distributed channel access* (EDCA) mechanism for contention-based transfer and a controlled channel access, referred to as the ***HCF controlled channel access (HCCA)*** mechanism, for contention-free transfer IEEE Std 802.11-2012, at p. 818. The HCCA mechanism manages access to the WM using an HC that has higher medium access priority than non-AP STAs. This allows it to transfer MSDUs to STAs and to allocate TXOPs to STAs IEEE Std 802.11-2012, at p. 881. MCCA enabled mesh STAs use management frames to make ***reservations for transmissions***. The mesh STA transmitting an MCCA Setup Request frame to initiate a reservation becomes the MCCAOP owner of the MCCAOP reservation. IEEE Std 802.11-2012, at p. 893. Packets of different types have different priorities. For example, 802.11 packets sent by STAs carry user priorities or DSCP priorities. . . . Priority mapping must be configured on network devices to retain the priorities of packets that traverse different networks. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, Priority Mapping.
[c] determining respective link utilization metrics for	The Huawei Wi-Fi Products further determine link utilization metrics for each data priority level for each communication link. For example, and without limitation, the IEEE 802.11 standards describe and require,

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
each data priority level for each communication link, and	and Huawei has implemented, link metrics that measure the amount of data transmitted on a link and also measure a link cumulatively for an ongoing traffic stream between two "QoS" stations, as described below: Huawei develops and optimizes the proprietary mesh routing protocol based on the 802.11s standard to implement route load balancing Huawei, Configuration Guide – WLAN-AC, at 741. Path selection protocol and path selection metric are identified by a unique identifier as defined in 8.4.2.100.2 and 8.4.2.100.3, respectively. Also, each path selection protocol and each path selection metric specifies the following: — Data type of metric values — Length of the metric field — Operator for aggregation of link metrics to a path metric; the symbol ⊕ is used to identify an arbitrary operator for aggregation — Comparison operator for determining a better or worse path; how this is performed depends on the actual comparison operator — Initial value of the path metric (path selection metric only) The standard defines a default mandatory path selection protocol (HWMP, 13.10) and a default mandatory path selection metric (airtime link metric, 13.9). Both shall be implemented on all mesh STAs to ensure interoperability. IEEE Std 802.11-2012, at p. 1381. A mesh STA may submit a link metric report to or request a link metric report from its neighbor peer mesh STA by transmitting a Mesh Link Metric Report frame. A mesh

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	STA receiving a Mesh Link Metric Report element with the Request subfield of the Flags field equal to 1 shall reply with a Mesh Link Metric Report frame containing the link metric value for the corresponding link IEEE Std 802.11-2012, at p. 1381. This subclause defines a default link metric that may be used by a path selection protocol to identify an efficient radio-aware path. The extensibility framework allows this metric to be overridden by any path selection metric as specified in the mesh profile. Airtime reflects the ***amount of channel resources consumed by transmitting the frame over a particular link***. This measure is approximate and designed for ease of implementation and interoperability. IEEE Std 802.11-2012, at p. 1381. The airtime for each link is calculated as follows: $c_a = \left[O + \frac{B_t}{r}\right]\frac{1}{1-e_f}$ where O and B_t are constants listed in Table 13-4 IEEE Std 802.11-2012, at p. 1381.

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	input parameter r is the data rate (in Mb/s) input parameter e_f is the frame error rate for the test frame size B_t rate r represents the data rate at which the mesh STA would transmit a frame of standard size B_t based on current conditions, and its estimation is dependent on local implementation of rate adaptation frame error rate e_f is the probability that when a frame of standard size B_t is transmitted at the current transmission bit rate r, the frame is corrupted due to transmission error; its estimation is a local implementation choice. Frame failures due to exceeding Mesh TTL should not be included in this estimate as they are not correlated with link performance. The airtime link metric shall be encoded as an unsigned integer in units of 0.01 TU. **Table 13-4—Airtime cost constants** Parameter / Recommended value / Description O / Varies depending on PHY / Channel access overhead, which includes frame headers, training sequences, access protocol frames, etc. B_t / 8192 / Number of bits in test frame IEEE Std 802.11-2012, at p. 1382.

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Table 13-5—Parameters of the airtime link metric for extensible path selection framework

Parameter	Notes
Path Selection Metric ID	See Table 8-178 in 8.4.2.100.3
Data type	Unsigned integer, $0 \leq$ metric value $< 4\,294\,967\,296$
Length of metric field	4 octets
Operator for metric aggregation	addition (+)
Comparison operator	*less than, equal to, greater than* as used with integers — metric *a* is *better than* metric *b* iff $a < b$ — metric *a* is *equal to* metric *b* iff $a = b$ — metric *a* is *worse than* metric *b* iff $a > b$
Initial value of path metric	0

IEEE Std 802.11-2012, at p. 1382, Table 13-5.

> "Mesh path selection enables path discovery over multiple instances of the wireless medium within a mesh BSS. The overview of the mesh path selection framework is described in 13.8. The hybrid wireless mesh protocol (HWMP) is defined as the default path selection protocol for the mesh BSS. HWMP provides both proactive path selection and reactive path selection. The details of HWMP are described in 13.10. The path selection protocol uses link metrics in the assessment of a mesh path to the destination." The airtime link metric is the default link metric. It is defined in 13.9.

IEEE Std 802.11-2012, at p. 66.

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	The Mesh Link Metric Report element is transmitted by a mesh STA to a neighbor peer mesh STA to indicate the quality of the link between the transmitting mesh STA and the neighbor peer mesh STA. The format of the Mesh Link Metric Report element is shown in Figure 8-367. IEEE Std 802.11-2012, at p. 691. The Transmit Stream/Category measurement is a request/report pair that ***enables a QoS STA to inquire of a peer QoS STA the condition of an ongoing traffic stream*** between them. The Transmit Stream/Category Measurement Report provides the transmit-side performance metrics for the measured traffic stream. Trigger conditions included in the Transmit Stream/Category Measurement Request may initiate triggered Transmit Stream/Category Measurement Reports upon detection of the trigger condition IEEE Std 802.11-2012, at p. 55. QoS traffic capability procedures enable the QoS STA to indicate that it is capable of transmitting traffic belonging to the corresponding ***user priority (UP)*** from applications that require generation of such traffic IEEE Std 802.11-2012, at p. 59. Within a mesh BSS, STAs utilize the mesh coordination function (MCF) to access the channel. MCF is based on the core QoS facilities specified in 4.3.7, and a mesh BSS is categorized as one type of QoS BSS. MCF is described in 9.20. IEEE Std 802.11-2012, at p. 62.

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[d] scheduling demand assigned time slots for establishing additional communication links with the neighboring mobile nodes for transmitting data therebetween based upon the link utilization metrics and data priority levels.	The Huawei Wi-Fi Products further schedule demand assigned time slots for establishing additional communication links with the neighboring mobile nodes for transmitting data therebetween based upon the link utilization metrics and data priority levels. For example, and without limitation, the IEEE 802.11 standards describe and require, and Huawei has implemented HCF and MCF functions, each of which coordinates scheduling of prioritized data transmissions with neighboring nodes in time slots. These functions schedule some of those time slots as demand assigned time slots, based on priority levels and link utilization metrics as is described below: *See* Claim element 1[b] above. **enhanced distributed channel access (EDCA):** The ***prioritized carrier sense multiple access with collision avoidance (CSMA/CA) access mechanism used by quality-of-service (QoS) stations*** (STAs) in a QoS basic service set (BSS). This access mechanism is also used by the QoS access point (AP) and operates concurrently with hybrid coordination function (HCF) controlled channel access (HCCA). **enhanced distributed channel access function (EDCAF):** A logical function in a quality-of-service (QoS) station (STA) that determines, using enhanced distributed channel access (EDCA), when a frame in the transmit queue with the associated access category (AC) is permitted to be transmitted via the wireless medium (WM). There is one EDCAF per AC. IEEE Std 802.11-2012, at p. 11. **mesh coordination function (MCF):** A coordination function that combines aspects of the contention based and scheduled access methods. The MCF includes the functionality provided by both ***enhanced distributed channel access (EDCA)*** and MCF controlled channel access (MCCA).

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	mesh coordination function (MCF) controlled channel access (MCCA): A coordination function for the mesh basic service set (MBSS). **mesh coordination function (MCF) controlled channel access opportunity (MCCAOP):** A period of time scheduled for frame transmissions between mesh stations (STAs) using MCF controlled channel access (MCCA). IEEE Std 802.11-2012, at p. 28. **4.3.7 QoS BSS: The QoS network** The IEEE 802.11 QoS facility provides MAC enhancements to support LAN applications with QoS requirements. The QoS enhancements are available to QoS STAs associated with a QoS access point in a QoS BSS. A subset of the QoS enhancements is available for use between STAs that are members of the same QoS IBSS. Similarly, a subset of the QoS enhancements is available for use between neighbor peer mesh STAs. A mesh BSS is one type of QoS BSS and it is described in 4.3.15. IEEE Std 802.11-2012, at p. 51. ***QoS traffic capability*** procedures enable the QoS STA to indicate that it is capable of transmitting traffic belonging to the corresponding ***user priority (UP)*** from applications that require generation of such traffic IEEE Std 802.11-2012, at p. 59. The first mechanism, designated the ***enhanced distributed channel access (EDCA), delivers traffic based on differentiating user priorities (UPs)***. This differentiation is achieved by varying the following for different UP values:

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	— Amount of time a STA senses the channel to be idle before backoff or transmission, or — The length of the contention window to be used for the backoff, or — The duration a STA may transmit after it acquires the channel. These transmissions may also be subject to certain channel access restrictions in the form of admission control. Details of this mechanism are provided in 9.19.2 IEEE Std 802.11-2012, at p. 51-52. The second mechanism, designated the hybrid coordination function (HCF) controlled channel access (HCCA), allows for the reservation of transmission opportunities (TXOPs) with the hybrid coordinator (HC). A STA based on its requirements requests the HC for TXOPs, both for its own transmissions as well as for transmissions from the AP to itself.[16] The request is initiated by the station management entity (SME) of the STA. The HC, which is collocated at the AP, either accepts or rejects the request based on an admission control policy. If the request is accepted, the HC schedules TXOPs for both STAs (both the AP and the non-AP STA). For transmissions from the non-AP STA, the HC polls the STA based on the parameters supplied by the STA at the time of its request. For transmissions to the STA, the AP directly obtains TXOPs from the collocated HC and delivers the queued frames to the STA, again based on the parameters supplied by the STA. Details of the mechanism are provided in 9.19.3 and 10.4. This mechanism may be used for applications such as voice and video, which may need periodic service from the HC. If the application constraints dictate the use of this mechanism, the application initiates this mechanism by using the management service primitives. IEEE Std 802.11-2012, at p. 52.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	Within a mesh BSS, STAs utilize the mesh coordination function (MCF) to access the channel. ***MCF is based on the core QoS facilities specified in 4.3.7***, and a mesh BSS is categorized as one type of QoS BSS. MCF is described in 9.20. IEEE Std 802.11-2012, at p. 62. The QoS facility includes an additional coordination function called *HCF* that is only usable in QoS network configurations. The HCF shall be implemented in all QoS STAs except mesh STAs. Instead, mesh STAs implement the MCF. The HCF combines functions from the DCF and PCF with some enhanced, QoS-specific mechanisms and frame subtypes to allow a uniform set of frame exchange sequences to be used for QoS data transfers during both the CP and CFP. The HCF uses both a contention-based channel access method, called the ***enhanced distributed channel access (EDCA)*** mechanism for contention-based transfer and a controlled channel access, referred to as the *HCF controlled channel access* (HCCA) mechanism, for contention-free transfer IEEE Std 802.11-2012, at p. 818.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION

A model of the reference implementation is shown in Figure 9-19 and illustrates a mapping from frame type or UP to AC: the four transmit queues and the four independent EDCAFs, one for each queue. The mapping of UP to the AC is described in 9.2.4.2 and Table 9-1. The mapping of frame types to ACs is described in 9.2.4.2.

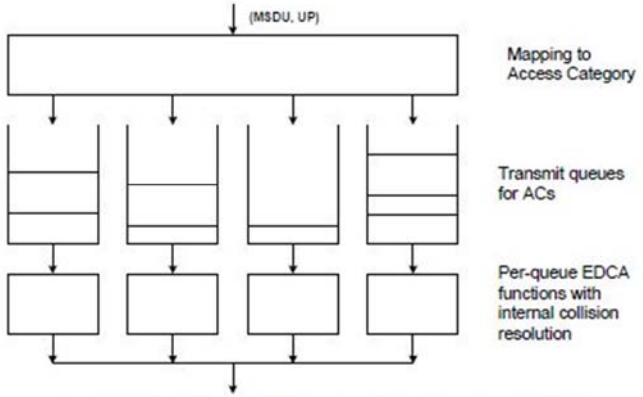


Figure 9-19—Reference implementation model

IEEE Std 802.11-2012, at p. 873, Figure 9-19.

At each of the above-described specific slot boundaries, each EDCAF shall initiate a transmission sequence if

— There is a frame available for transmission at that EDCAF, and

— The backoff timer for that EDCAF has a value of 0, and

— Initiation of a transmission sequence is not allowed to commence at this time for an EDCAF of higher UP.

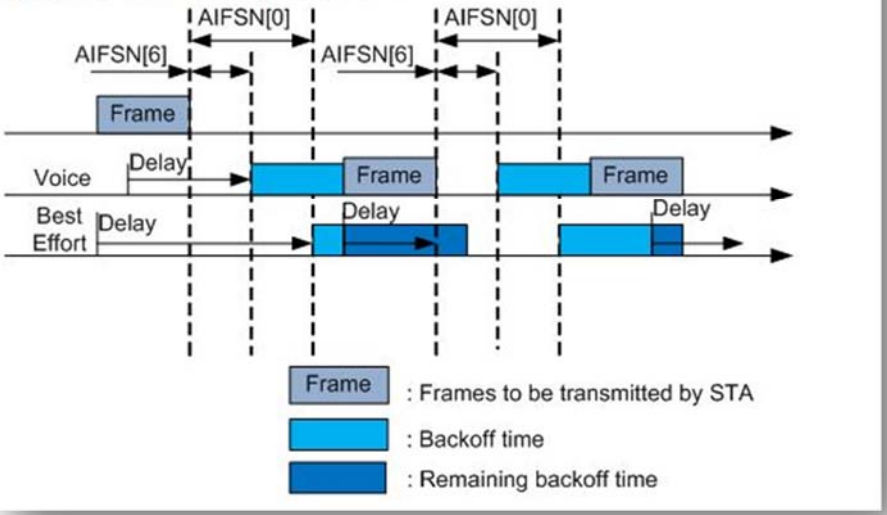
***Harris Corporation v. Huawei, et al* – Case No. 2:18-cv-439**
Plaintiff's Disclosure of Asserted Claims and Infringement Contentions (Pat. L.R. 3-1 & 3-2)
Exhibit B – U.S. Patent No. 6,958,986 ('986) – Claims 1, 5-6, 9, 17, 21-22, 25

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	IEEE Std 802.11-2012, at p. 876. MCF implements the same EDCA (see 9.19.2) as does HCF. IEEE Std 802.11-2012, at p. 892.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	B.4.15 QoS enhanced distributed channel access (EDCA) IEEE Std 802.11-2012, at p. 1831.

Item	Protocol capability	References	Status
QD1	Support for four transmit queues with a separate channel access entity associated with each	9.2.4.2, 9.19.2.1	CF12:M
QD2	Per-channel access function differentiated channel access	9.19.2.2, 9.19.2.3, 9.19.2.5	CF12:M
QD3	Multiple frame transmission support	9.19.2.4	CF12:O
QD4	Maintenance of within-queue ordering, exhaustive retransmission when sending non-QoS data frames	9.19.2.6	CF12:M
QD5	Interpretation of admission control mandatory (ACM) bit in EDCA Parameter Set element	8.4.2.15, 9.19.4.2	(CF2.1 & CF12):M
QD6	Contention-based admission control	9.19.4.2, 8.4.2.16, 8.4.2.17, 8.5.3.2–8.5.3.4, 10.4	(CF1 & CF12):O (CF2.1 & CF12):O
QD7	Power management in an infrastructure BSS or in an IBSS	10.2	(CF1 and CF12):O (CF2 and CF12):O
QD8	Default EDCA parameters for communications outside context of BBS	8.4.2.31, 9.19.2.2	CF2.3:M

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	Packets of different types have different priorities. For example, 802.11 packets sent by STAs carry user priorities or DSCP priorities. . . . Priority mapping must be configured on network devices to retain the priorities of packets that traverse different networks. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, Priority Mapping. **EDCA parameters** WMM defines a set of Enhanced Distributed Channel Access (EDCA) parameters, which ***distinguishes high priority packets and enables these packets to preempt channels***. WMM classifies data packets into four access categories (ACs). Table 10-1 shows the mappings between ACs and 802.11 user preferences (UPs). A large UP value indicates a high priority. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM. Each AC queue defines a set of EDCA parameters, which determines the capability of occupying channels. These parameters ensure that ***high priority ACs have a higher probability of preempting channels than low priority ones***. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM.

'986 PATENT CLAIM 1	INFRINGEMENT BY HUAWEI CORPORATION
	As shown in Figure 10-3, the AIFSN (AIFSN[6]) and the backoff time of voice packets are shorter than those of Best Effort packets. When both voice packets and Best Effort packets need to be sent, voice packets preempt the channel. Figure 10-3 WMM working mechanism  S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM.

'986 PATENT CLAIM 5	**INFRINGEMENT BY HUAWEI CORPORATION**
5. The wireless communication network of claim 1 wherein each link utilization metric is determined based upon a quantity of data sent during at least one prior semi-permanent time slot corresponding to the respective priority level.	The Huawei '986 Patent Accused Products infringe this claim. *See* Claim 1. The Huawei Wi-Fi Products incorporate link utilization metrics determined based upon a quantity of data sent during at least one prior semi-permanent time slot corresponding to the respective priority level. For example, and without limitation, the IEEE 802.11 standards describe and require, and Huawei has implemented both per-frame and cumulative link utilization metrics that may be based on data sent during a prior semi-permanent (e.g., reserved) time slot corresponding to the respective priority level, as is described below: *See* Claim elements 1[b] and 1[c] above. > Airtime reflects the ***amount of channel resources consumed by transmitting the frame over a particular link***. This measure is approximate and designed for ease of implementation and interoperability. IEEE Std 802.11-2012, at p. 1381. > The Transmit Stream/Category measurement is a request/report pair that ***enables a QoS STA to inquire of a peer QoS STA the condition of an ongoing traffic stream*** between them. The Transmit Stream/Category Measurement Report provides the transmit-side performance metrics for the measured traffic stream. Trigger conditions included in the Transmit Stream/Category Measurement Request may initiate triggered Transmit Stream/Category Measurement Reports upon detection of the trigger condition IEEE Std 802.11-2012, at p. 55. > **hybrid coordination function (HCF):** A coordination function that combines and enhances aspects of the contention-based and contention-free access methods to provide ***quality-of-service (QoS) stations (STAs) with prioritized and parameterized QoS access to the wireless medium*** (WM), while continuing to support non-QoS STAs for best-effort transfer. The HCF includes the functionality provided by both enhanced

'986 PATENT CLAIM 5	INFRINGEMENT BY HUAWEI CORPORATION
	distributed channel access (EDCA) and HCF controlled channel access (HCCA). The HCF is compatible with the distributed coordination function (DCF) and the point coordination function (PCF). It supports a uniform set of frame formats and exchange sequences that STAs might use during both the contention period (CP) and the contention-free period (CFP). IEEE Std 802.11-2012, at p. 12. **hybrid coordinator (HC):** A type of coordinator, defined as part of the quality-of-service (QoS) facility, that implements the frame exchange sequences and medium access control (MAC) service data unit (MSDU) handling rules defined by the hybrid coordination function (HCF). The HC operates during both the contention period (CP) and contention-free period (CFP). The HC ***performs bandwidth management including the allocation of transmission opportunities (TXOPs) to QoS stations*** (STAs). The HC is collocated with a QoS access point (AP). IEEE Std 802.11-2012, at p. 12. **hybrid coordination function (HCF) controlled channel access (HCCA):** The channel access mechanism utilized by the hybrid coordinator (HC) to ***coordinate contention-free media use by quality-of-service (QoS) stations*** (STAs) for downlink individually addressed, uplink, and direct-link transmissions. IEEE Std 802.11-2012, at p. 12. **mesh coordination function (MCF):** A coordination function that combines aspects of the contention based and scheduled access methods. The MCF includes the functionality provided by both enhanced distributed channel access (EDCA) and MCF controlled channel access (MCCA).

'986 PATENT CLAIM 5	**INFRINGEMENT BY HUAWEI CORPORATION**
	mesh coordination function (MCF) controlled channel access (MCCA): A coordination function for the mesh basic service set (MBSS). **mesh coordination function (MCF) controlled channel access opportunity (MCCAOP):** A period of time ***scheduled for frame transmissions between mesh stations (STAs) using MCF controlled channel access*** (MCCA). IEEE Std 802.11-2012, at p. 58.

'986 PATENT CLAIM 6	**INFRINGEMENT BY HUAWEI CORPORATION**
6. The wireless communication network of claim 1 wherein said controller further comprises a queue for storing data prior to transmitting, and wherein each link utilization metric is determined based upon a quantity of data corresponding to the respective priority level in said queue.	The Huawei '986 Patent Accused Products infringe this claim. *See* Claim 1. The Huawei Wi-Fi Products incorporate queues for storing data prior to transmitting, and wherein each link utilization metric is determined based upon a quantity of data corresponding to the respective priority level in said queue. For example, and without limitation, the IEEE 802.11 standards describe and require, and Huawei has implemented multiple transmit queues for data of respective priority levels, a mechanism for higher priority channels to preempt transmission for multiple frames, and both per-frame and cumulative link utilization metrics, as is described below: *See* Claim elements 1[c] and 1[d] above. Airtime reflects the ***amount of channel resources consumed by transmitting the frame over a particular link***. This measure is approximate and designed for ease of implementation and interoperability. IEEE Std 802.11-2012, at p. 1381.

'986 PATENT CLAIM 6	INFRINGEMENT BY HUAWEI CORPORATION
	The Transmit Stream/Category measurement is a request/report pair that ***enables a QoS STA to inquire of a peer QoS STA the condition of an ongoing traffic stream*** between them. The Transmit Stream/Category Measurement Report provides the transmit-side performance metrics for the measured traffic stream. Trigger conditions included in the Transmit Stream/Category Measurement Request may initiate triggered Transmit Stream/Category Measurement Reports upon detection of the trigger condition IEEE Std 802.11-2012, at p. 55. **enhanced distributed channel access (EDCA):** The prioritized carrier sense multiple access with collision avoidance (CSMA/CA) access mechanism used by quality-of-service (QoS) stations (STAs) in a QoS basic service set (BSS). This access mechanism is also used by the QoS access point (AP) and operates concurrently with hybrid coordination function (HCF) controlled channel access (HCCA). **enhanced distributed channel access function (EDCAF):** A logical function in a quality-of-service (QoS) station (STA) that determines, using enhanced distributed channel access (EDCA), ***when a frame in the transmit queue with the associated access category (AC) is permitted to be transmitted via the wireless medium*** (WM). There is one EDCAF per AC. IEEE Std 802.11-2012, at p. 11.

'986 PATENT CLAIM 6	INFRINGEMENT BY HUAWEI CORPORATION

A model of the reference implementation is shown in Figure 9-19 and illustrates a mapping from frame type or UP to AC: the four transmit queues and the four independent EDCAFs, one for each queue. The mapping of UP to the AC is described in 9.2.4.2 and Table 9-1. The mapping of frame types to ACs is described in 9.2.4.2.

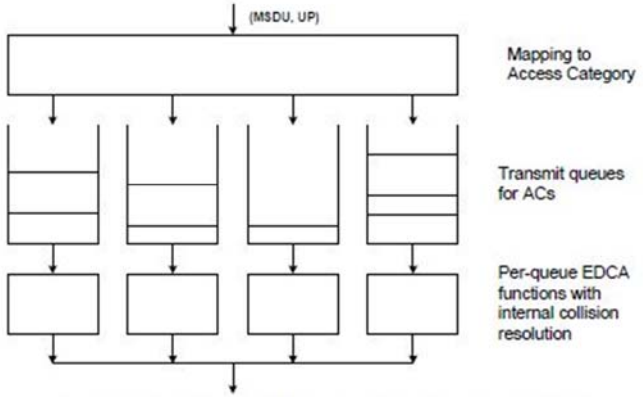


Figure 9-19—Reference implementation model

IEEE Std 802.11-2012, at p. 873, Figure 9-19.

At each of the above-described specific slot boundaries, each EDCAF shall initiate a transmission sequence if

— There is a frame available for transmission at that EDCAF, and

— The backoff timer for that EDCAF has a value of 0, and

— Initiation of a transmission sequence is not allowed to commence at this time for an EDCAF of higher UP.

'986 PATENT CLAIM 6	INFRINGEMENT BY HUAWEI CORPORATION

IEEE Std 802.11-2012, at p. 876.

B.4.15 QoS enhanced distributed channel access (EDCA)

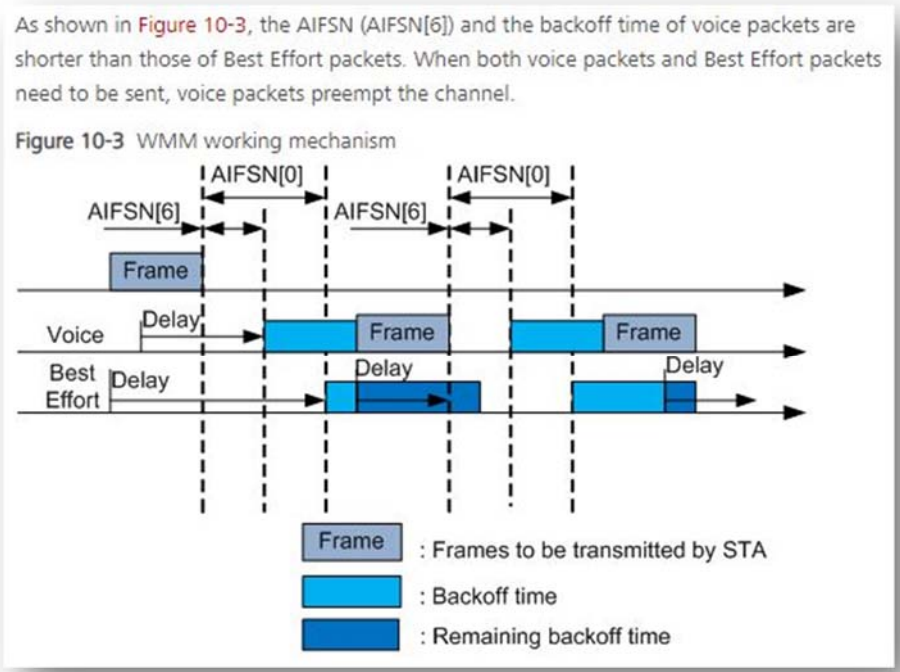
Item	Protocol capability	References	Status
QD1	Support for four transmit queues with a separate channel access entity associated with each	9.2.4.2, 9.19.2.1	CF12:M
QD2	Per-channel access function differentiated channel access	9.19.2.2, 9.19.2.3, 9.19.2.5	CF12:M
QD3	Multiple frame transmission support	9.19.2.4	CF12:O
QD4	Maintenance of within-queue ordering, exhaustive retransmission when sending non-QoS data frames	9.19.2.6	CF12:M
QD5	Interpretation of admission	8.4.2.15, 9.19.4.2	(CF2.1 & CF12):M

IEEE Std 802.11-2012, at p. 1831.

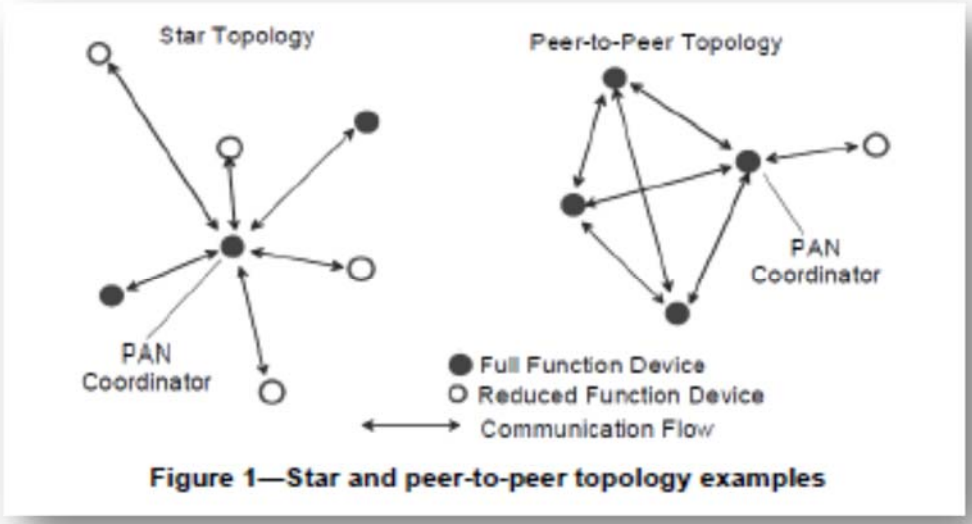
EDCA parameters

WMM defines a set of Enhanced Distributed Channel Access (EDCA) parameters, which ***distinguishes high priority packets and enables these packets to preempt channels***.

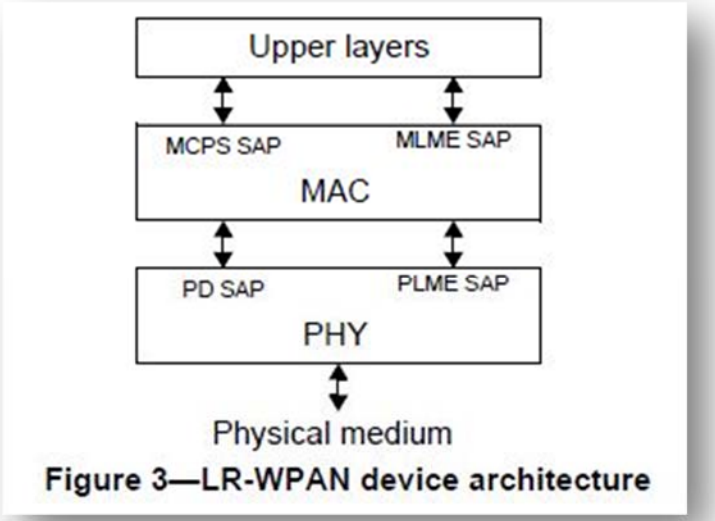
'986 PATENT CLAIM 6	INFRINGEMENT BY HUAWEI CORPORATION
	WMM classifies data packets into four access categories (ACs). Table 10-1 shows the mappings between ACs and 802.11 user preferences (UPs). A large UP value indicates a high priority. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM. Each AC queue defines a set of EDCA parameters, which determines the capability of occupying channels. These parameters ensure that ***high priority ACs have a higher probability of preempting channels than low priority ones***. S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM.

'986 PATENT CLAIM 6	INFRINGEMENT BY HUAWEI CORPORATION
	 S5720HI V200R010C00 Configuration Guide - WLAN-AC, *available at* https://support.huawei.com/enterprise/en/doc/EDOC1000142094/358c72bf/understanding-mesh, at Understanding WLAN QoS, WMM.

***Harris Corporation v. Huawei, et al* – Case No. 2:18-cv-439**
Plaintiff's Disclosure of Asserted Claims and Infringement Contentions (Pat. L.R. 3-1 & 3-2)
Exhibit B – U.S. Patent No. 6,958,986 ('986) – Claims 1, 5-6, 9, 17, 21-22, 25

'986 PATENT CLAIM 9	**INFRINGEMENT BY HUAWEI CORPORATION**
A wireless communications network comprising:	The Huawei '986 Patent Accused Products infringe this claim. The Huawei '986 Patent Accused Products incorporate a wireless communications network. *See* Claim 25 below.
[a] a plurality of mobile nodes each comprising a wireless transceiver and a controller for controlling said wireless transceiver, said controller comprising a data queue and also for	The Huawei '986 Patent Accused Products incorporate a wireless communication network comprising mobile nodes each comprising a wireless transceiver and a controller for controlling said wireless transceiver, said controller comprising a data queue. *See* Claim element 25[preamble] below. Zigbee and IEEE 802.15.4 standards describe and require a wireless communication network comprising a number of mobile nodes. For example, and without limitation:  **Figure 1—Star and peer-to-peer topology examples**

'986 PATENT CLAIM 9	**INFRINGEMENT BY HUAWEI CORPORATION**
	IEEE Std 802.15.4-2011, at p. 9, Figure 1. "A system conforming to this standard consists of several components. The most basic is the device. Two or more devices communicating on the same physical channel constitute a WPAN." IEEE Std 802.15.4-2011, at p. 8. "An LR-WPAN device comprises . . . a MAC sublayer that provides access to the physical channel for all types of transfer. Figure 3 shows these blocks in a graphical representation, which are described in more detail in 4.4.1 and 4.4.2." IEEE Std 802.15.4-2011, at p. 11. The features of the PHY are activation and deactivation of the radio transceiver, ED, LQI, channel selection, clear channel assessment (CCA), and transmitting as well as receiving packets across the physical medium." IEEE Std 802.15.4-2011, at p. 11.

'986 PATENT CLAIM 9	INFRINGEMENT BY HUAWEI CORPORATION
	 **Figure 3—LR-WPAN device architecture** IEEE Std 802.15.4-2011, at p. 11, Figure 3. If a single transmission attempt has failed and the transmission was indirect, the coordinator shall not retransmit the data or MAC command frame. Instead, the frame shall remain in the transaction queue of the coordinator and can only be extracted following the reception of a new data request command. If a new data request command is received, the originating device shall transmit the frame using the same DSN as was used in the original transmission. IEEE Std 802.15.4-2011, at p. 46.

'986 PATENT CLAIM 9	**INFRINGEMENT BY HUAWEI CORPORATION**
[b] scheduling respective semi-permanent time slots to establish communication links with neighboring mobile nodes for transmitting data stored in said data queues therebetween,	*See* Claim element 25[a] below.
[c] determining link utilization metrics for each communication link based upon a quantity of data previously sent over the communication link during the semi-permanent time slots and the data queue, and	*See* Claim element 25[b] below.
[d] scheduling demand assigned time slots for establishing additional communication links with said neighboring mobile nodes for transmitting the data based upon the link utilization metrics.	*See* Claim element 25[c] below.

'986 PATENT CLAIM 17	**INFRINGEMENT BY HUAWEI CORPORATION**
17. A communication method for a wireless communication network comprising a plurality of mobile nodes, the method comprising:	The Huawei '986 Patent Accused Products infringe this claim. *See* claim elements 1[preamble] and 1[a] above.
[a] scheduling a respective semi-permanent time slot to establish communication links between respective pairs of mobile nodes for transmitting data therebetween, the data having different priority levels;	*See* Claim element 1[b] above.
[b] determining respective link utilization metrics for each data priority level for each communication link; and	*See* Claim element 1[c] above.
[c] scheduling demand assigned time slots for establishing additional communication links between the pairs of mobile nodes for transmitting data	*See* Claim element 1[d] above.

therebetween based upon the link utilization metrics and data priority levels.	

'986 PATENT CLAIM 21	**INFRINGEMENT BY HUAWEI CORPORATION**
21. The method of claim 17 wherein determining comprises determining each link utilization metric based upon a quantity of data sent during at least one prior semi-permanent time slot corresponding to the respective priority level.	The Huawei '986 Patent Accused Products infringe this claim. *See* Claim 5 above.

'986 PATENT CLAIM 22	**INFRINGEMENT BY HUAWEI CORPORATION**
22. The method of claim 17 wherein each mobile node comprises a queue for storing data prior to transmitting, and wherein the link utilization metrics are determined based upon quantities of data in the	The Huawei '986 Patent Accused Products infringe this claim. *See* Claim 6 above.

'986 PATENT CLAIM 22	**INFRINGEMENT BY HUAWEI CORPORATION**
queues corresponding to respective priority levels.	

'986 PATENT CLAIM 25	**INFRINGEMENT BY HUAWEI CORPORATION**
25. A communication method for a wireless communication network comprising a plurality of mobile nodes each comprising a data queue, the method comprising:	The Huawei '986 Patent Accused Products infringe this claim. The Huawei '986 Patent Accused Products incorporate a wireless communication network comprising a plurality of mobile nodes each comprising a data queue. The Huawei '986 Patent Accused Products include the Huawei Wi-Fi Products and the Huawei Zigbee Products. **Huawei Wi-Fi Products** *See* Claim elements 1[preamble] and 1[a], and Claim 6 above. **Huawei Zigbee Products** Huawei is a "Promoter" level member of the Zigbee Alliance and produces products certified by Zigbee. *See, e.g.*, Zigbee Alliance, Our Members, *available at* https://www.zigbee.org/zigbeealliance/our-members/ (last accessed March 27, 2019); Zigbee Alliance, Zigbee Certified Products, *available at* https://www.zigbee.org/zigbee-products-2/#zigbeecertifiedproducts/?view_30_search=Huawei&view_30_page=1 (last accessed March 27, 2019). The Huawei Zigbee Products comply with the Zigbee standards, including the IEEE 802.15.4 standard (defining the Medium Access Control (MAC) and Physical (PHY) sublayers for Low-Rate Wireless Personal Area Networks (LR-WPANs) connectivity), which is the basis for the MAC and PHY layers in

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	Zigbee certified products. *See, e.g.*, Zigbee Alliance, Zigbee 3.0, *available at* https://www.zigbee.org/zigbee-for-developers/zigbee-3-0/ (last accessed March 27, 2019); *see also* ZigBee Alliance, ZigBee Specification, Version r06 (June 27, 2005), at 17-18; ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 1 ("The IEEE 802.15.4 standard defines the two lower layers: the physical (PHY) layer and the medium access control (MAC) sub-layer. The ZigBee Alliance builds on this foundation by providing the network (NWK) layer and the framework for the application layer.").

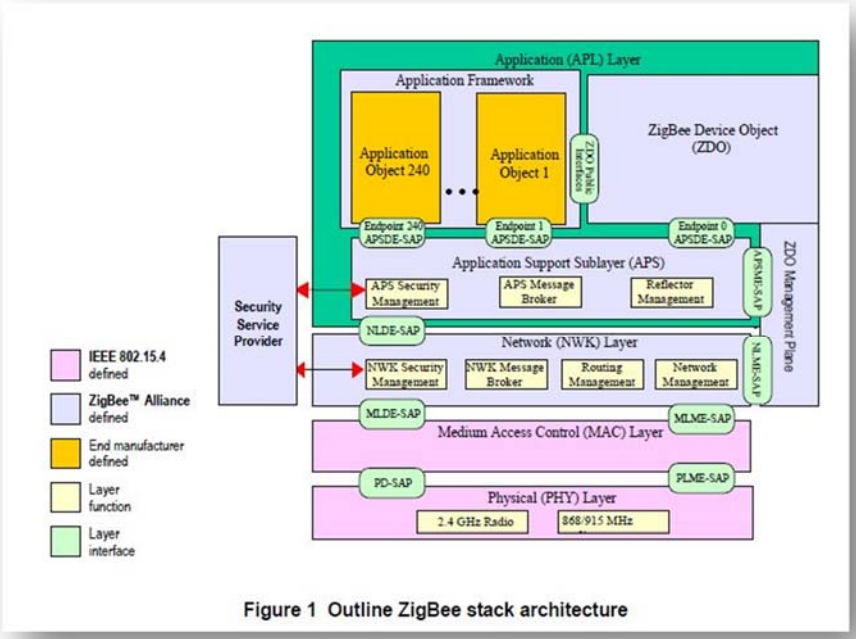
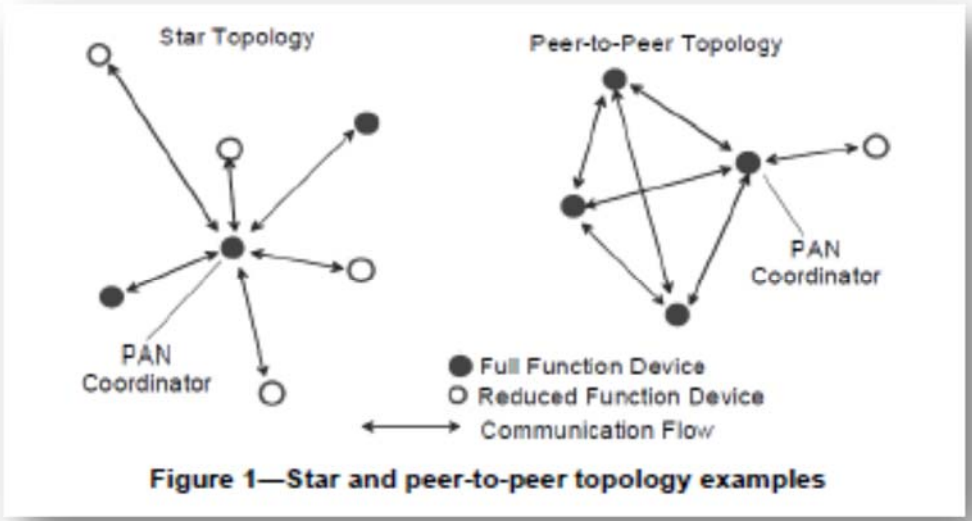


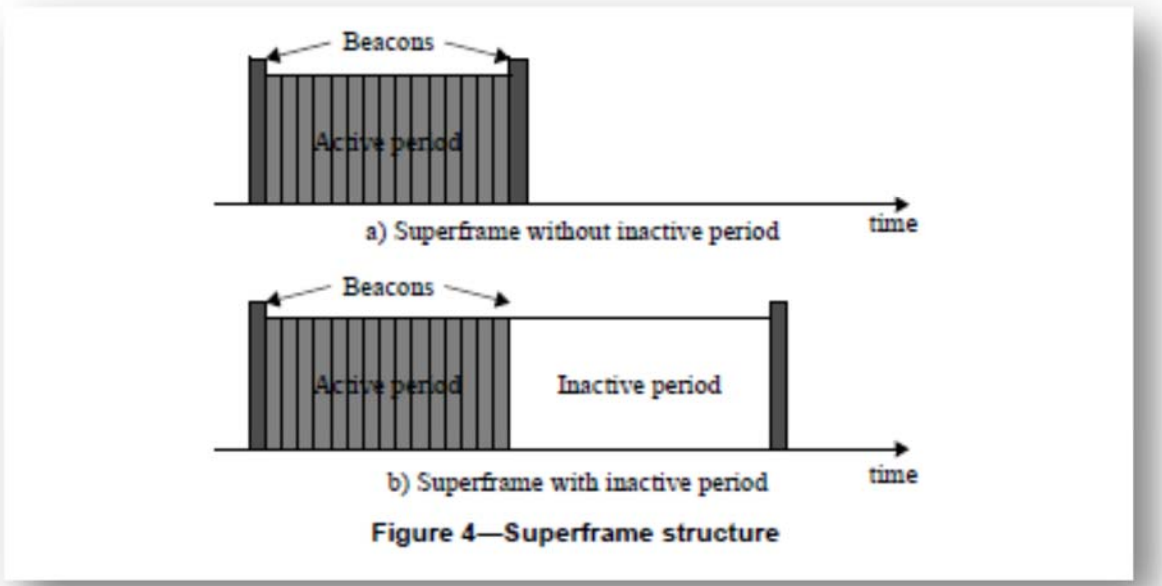
Figure 1 Outline ZigBee stack architecture

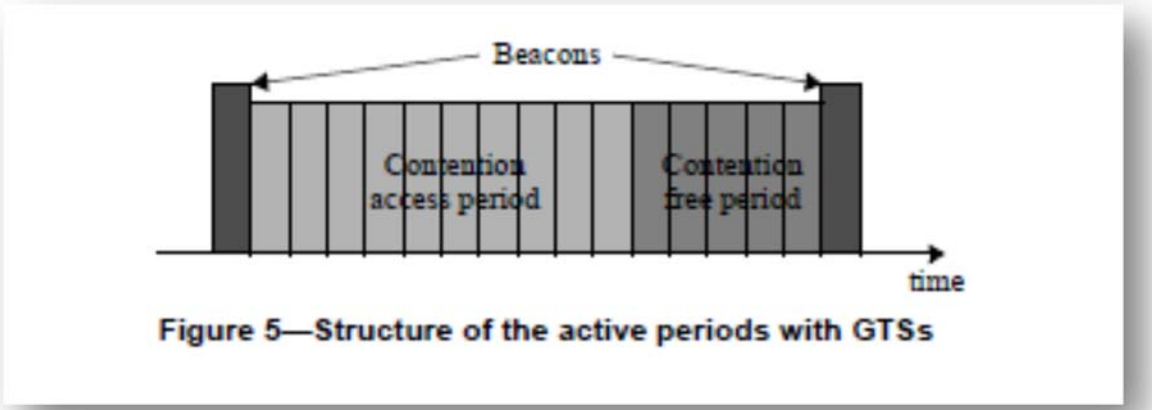
'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	ZigBee Alliance, ZigBee Specification, Version r06 (June 27, 2005), at p. 18, Figure 1. Huawei represents that certain of its products comply with and communicate according to the Zigbee standards. For example: This topic introduces the wireless network access indicators of the ONT. **Table 9-1** Zigbee/Z-Wave access indicators **Indicator** / **Value(ZigBee)** / **Value(Z-Wave)** Standards compliance / IEEE 802.15.4 For ZHA1.2 and ZLL1.0 device management / ITU-T G.9959 For device plus management Communication frequency / 2.4GHz / • Australian standard: 908.4-916 MHz • U.S. standard: 919.8-921.42 MHz Echolife ONT, Port Specifications, Jan. 24, 2019, at 10. "The AR502 series IoT gateway is designed for industrial environments and supports communication in harsh environments such as extreme temperature, high humidity, and electromagnetic interference. The built-in industrial-grade LTE module supports high bandwidth, low-latency wireless access, and various local interfaces (RS485/RS422, RS232, Gigabit Ethernet and ZigBee) for connecting serial interface devices, Ethernet devices. The AR502 applies to multiple IoT fields, such as smart grid and smart transportation."

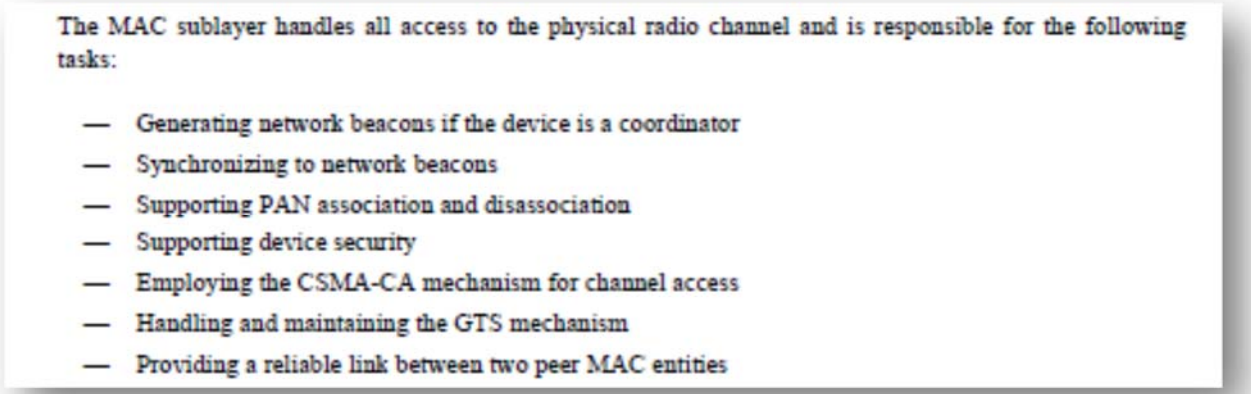
'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	Huawei AR502 Series IoT Gateway, Datasheet, at 2; *see also* Huawei AP7060DN Access Point Datasheet, *available at* https://e.huawei.com/us/related-page/products/enterprise-network/wlan/indoor-access-points/ap7060dn/wlan-ap7060dn (last accessed March 28, 2019), at 3; Huawei AR160-M Series Enterprise Routers Data Sheet, *available at* https://e.huawei.com/it/related-page/products/enterprise-network/routers/ar-agile/ar160-m/router_ar160-m, at 2. Zigbee and IEEE 802.15.4 standards describe and require a wireless communication network comprising a number of mobile nodes.  **Figure 1—Star and peer-to-peer topology examples**

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	IEEE Standard for Local and Metropolitan Area Networks – Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs), IEEE Computer Society, IEEE Std 802.15.4-2011, at p. 9, Figure 1. These mobile nodes further include data queues that store pending data and command frames for transmission. coordinator: A device in an low rate wireless personal area network (LR WPAN) that provides synchronization services to other devices in the LR WPAN. IEEE Std 802.15.4-2011, at p. 4. The association response command shall be sent to the device requesting association using indirect transmission; i.e., the association response ***command frame*** shall be added to ***the list of pending transactions*** stored on the coordinator and extracted at the discretion of the device concerned using the method described in 5.1.6.3. IEEE Std 802.15.4-2011, at p. 33. If a single transmission attempt has failed and the transmission was indirect, the coordinator shall not retransmit the ***data or MAC command frame***. Instead, the ***frame shall remain in the transaction queue of the coordinator*** and can only be extracted following the reception of a new data request command. If a new data request command is received, the originating device shall transmit the frame using the same DSN as was used in the original transmission. IEEE Std 802.15.4-2011, at p. 46. For either a beacon-enabled PAN or a nonbeacon-enabled PAN, if the transmission is direct and originates due to a primitive issued by the next higher layer and the CSMA-CA algorithm fails, the next higher layer shall be notified. If the transmission is indirect

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	and the CSMA-CA algorithm fails, the frame shall remain in the ***transaction queue*** until it is requested again and successfully transmitted or until the transaction expires. IEEE Std 802.15.4-2011, at p. 41. The effect on receipt of the MLME-Poll.indication primitive is that the next higher layer is notified that a device is requesting to see if there is ***a pending MAC data frame***. If an indirect ***frame is queued by the higher layer*** during the processing of an MLME-POLL.indication it shall affect the pending bit in the ACK frame corresponding to the data request frame that caused the MLME-POLL.indication to be issued ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 491. The method further comprises the steps below.
[a] scheduling respective semi-permanent time slots to establish communication links between respective pairs of mobile nodes for transmitting data stored in the data queues therebetween;	**Huawei Wi-Fi Products** *See* Claim element 1[b] and Claim 6 above. **Huawei Zigbee Products** The Huawei Zigbee Products further schedule respective semi-permanent time slots to establish communication links between respective pairs of mobile nodes for transmitting data stored in the data queues therebetween. For example, and without limitation, the products schedule Guaranteed Time Slots for transmission of queued data during the Contention Free Period of Superframes: The features of the MAC sublayer are beacon management, channel access, ***GTS management***, frame validation, acknowledged frame delivery, association, and disassociation.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	IEEE Std 802.15.4-2011, at p. 11.  **Figure 4—Superframe structure** IEEE Std 802.15.4-2011, at p. 12, Figure 4.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	 **Figure 5—Structure of the active periods with GTSs** IEEE Std 802.15.4-2011, at p. 12, Figure 5. This standard allows the optional use of a superframe structure. The format of the superframe is defined by the coordinator. The superframe is bounded by network beacons sent by the coordinator, as illustrated in Figure 4a), and is divided into 16 slots of equal duration. . . . The beacons are used to synchronize the attached devices, to identify the PAN, and to describe the structure of the superframes. IEEE Std 802.15.4-2011, at p. 12. Any device wishing to communicate during the contention access period (CAP) between two beacons competes with other devices using a slotted CSMA-CA or ALOHA mechanism, as appropriate. For low-latency applications or applications requiring specific data bandwidth, the PAN coordinator dedicates portions of the active superframe to that application. These portions are called ***guaranteed time slots (GTSs***). The GTSs

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	form the contention-free period (CFP), which always appears at the end of the active superframe starting at a slot boundary immediately following the CAP, as shown in Figure 5. The PAN coordinator allocates up to seven of these GTSs, and a GTS is allowed to occupy more than one slot period. . . . Also each device transmitting in a GTS ensures that its transaction is complete before the time of the next GTS or the end of the CFP. IEEE Std 802.15.4-2011, at p. 12.  The MAC sublayer handles all access to the physical radio channel and is responsible for the following tasks: — Generating network beacons if the device is a coordinator — Synchronizing to network beacons — Supporting PAN association and disassociation — Supporting device security — Employing the CSMA-CA mechanism for channel access — Handling and maintaining the GTS mechanism — Providing a reliable link between two peer MAC entities IEEE Std 802.15.4-2011, at p. 18. PANs that wish to use the superframe structure (referred to as beacon-enabled PANs) shall set *macBeaconOrder* to a value between 0 and 14, both inclusive, and *macSuperframeOrder* to a value between 0 and the value of *macBeaconOrder*, both inclusive.

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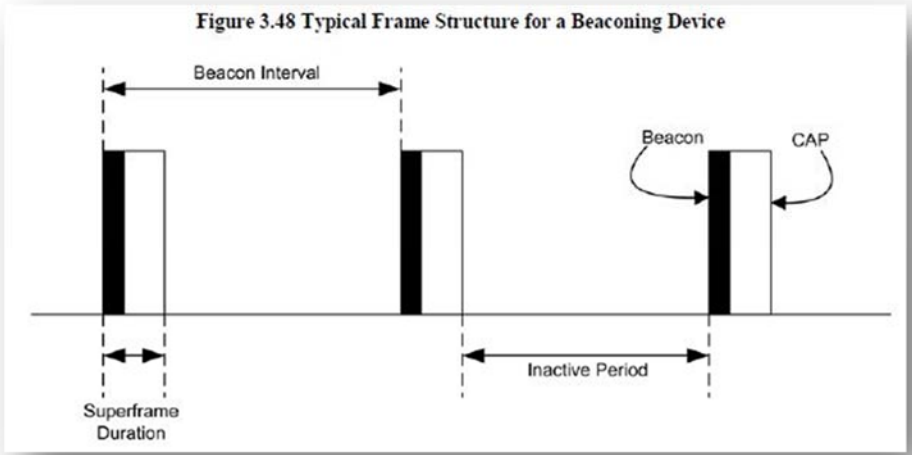
	The CAP shall be at least a*MinCAPLength*, unless additional space is needed to temporarily accommodate the increase in the beacon frame length needed to perform GTS maintenance, as described in 5.2.2.1.3, and shall shrink or grow dynamically to accommodate the size of the CFP. IEEE Std 802.15.4-2011, at pp. 19-20. All beacon frames, as defined in 5.2.2.1, shall be transmitted at the beginning of each superframe at an interval equal to *aBase-SuperframeDuration*×2n, where n is the value of *macBeaconOrder*….Beacon transmissions shall be given priority over all other transmit and receive operations IEEE Std 802.15.4-2011, at p. 32. All devices operating on a beacon-enabled PAN (i.e., macBeaconOrder< 15) shall be able to acquire beacon synchronization in order to detect any pending messages or to track the beacon. IEEE Std 802.15.4-2011, at p. 37. A device on a beacon-enabled PAN can determine whether any frames are pending for it by examining the contents of the received beacon frame, as described in 5.1.4.1. IEEE Std 802.15.4-2011, at p. 43. the frame shall remain in the transaction queue of the Coordinator IEEE Std 802.15.4-2011, at p. 46.

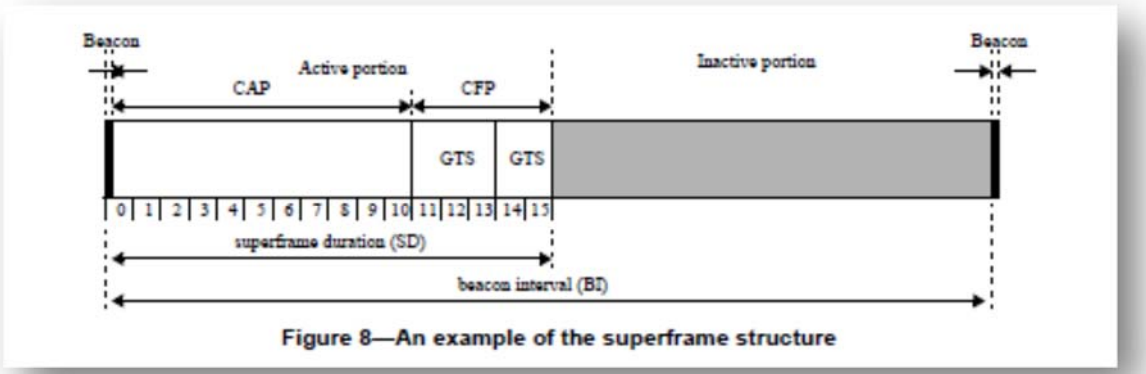
The ZigBee coordinator shall determine the beacon order and superframe order for every device in the network (see [B1] for more information on these attributes). Because one purpose of multi-hop beaconing networks is to allow routing nodes the opportunity to sleep in order to conserve power, the beacon order shall be set much larger than the superframe order. Setting the attributes in this manner makes it possible to schedule the active portion of the superframes of every device in any neighborhood such that they are non-overlapping in time. In other words, time is divided into approximately (*macBeaconInterval*/*macSuperframeDuration*) non-overlapping time slots, and the active portion of the superframe of every device in the network shall occupy one of these non-overlapping time slots. An example of the resulting frame structure for a single beaconing device is shown in Figure 3.48.

ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 352.



ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 352, Figure 3.48.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	For low-latency applications or applications requiring specific data bandwidth, the PAN coordinator dedicates portions of the active superframe to that application. These portions are called ***guaranteed time slots*** (GTSs). IEEE Std 802.15.4-2011, at p. 12. ***GTSs shall be allocated on a first-come-first-served basis by the PAN coordinator*** provided there is sufficient bandwidth available. IEEE Std 802.15.4-2011, at p. 49. If there was not sufficient capacity to allocate the requested GTS, the start slot shall be set to zero and the length to the largest GTS length that can currently be supported. The PAN coordinator shall then include this GTS descriptor in its beacon and update the GTS Specification field of the beacon frame accordingly. IEEE Std 802.15.4-2011, at p. 50. If a valid GTS is found, the MAC sublayer shall transmit the data during the GTS, i.e., between its starting slot and its starting slot plus its length. At this time, the MAC sublayer shall ***transmit the MPDU immediately without using CSMA-CA, provided the requested transaction can be completed before the end of the GTS***. If the requested transaction cannot be completed before the end of the current GTS, the MAC sublayer shall defer the transmission until the specified GTS in the next superframe. IEEE Std 802.15.4-2011, at p. 50.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	 Figure 8—An example of the superframe structure IEEE Std 802.15.4-2011, at p. 20, Figure 8.
[b] determining link utilization metrics for each communication link based upon a quantity of data previously sent over the communication link during the semi-permanent time slots and the data queues; and	**Huawei Wi-Fi Products** *See* claim elements 1[b] and 1[c], and Claim 5 above. **Huawei Zigbee Products** The Huawei Zigbee Products further determine link utilization metrics for each communication link based upon a quantity of data previously sent over the communication link during the previous time slots and the data queues. For example, and without limitation, the products determine a link cost measurement based on the quantity of data received with respect to data lost and re-queued for transmission, or an equivalent (and substantially similar) estimate of that measurement using a Link Quality Indicator, as described below:

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	The ZigBee routing algorithm uses a path cost metric for route comparison during route discovery and maintenance. In order to compute this metric, a cost, known as the link cost, is associated with each link in the path and link cost values are summed to produce the cost for the path as a whole. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 338. where *pl* is defined as the probability of packet delivery on the link *l*. Thus, implementers may report a constant value of 7 for link cost or they may report a value that reflects the probability *pl* of reception — specifically, the reciprocal of that probability — which should, in turn, reflect the number of expected attempts required to get a packet through on that link each time it is used. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 338. *pl* may be estimated over time by actually ***counting received beacon and data frames and observing the appropriate sequence numbers to detect lost frames***. This is generally regarded as the most accurate measure of reception probability. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 338. However, the most straightforward method, available to all, is to form estimates based on an average over the per-frame LQI value provided by the IEEE 802.15.4-2003 MAC and PHY. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 338.

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LQI	Integer	0x00 – 0xff	The estimated link quality for RF transmissions from this device. See section 3.6.3.1 for a discussion of how this is calculated. This field shall be present in every neighbor table entry.
Outgoing Cost	Integer	0x00 - 0xff	The cost of an outgoing link as measured by the neighbor. A value of 0 indicates no outgoing cost is available. This field is mandatory if *nwkSymLink* = TRUE.

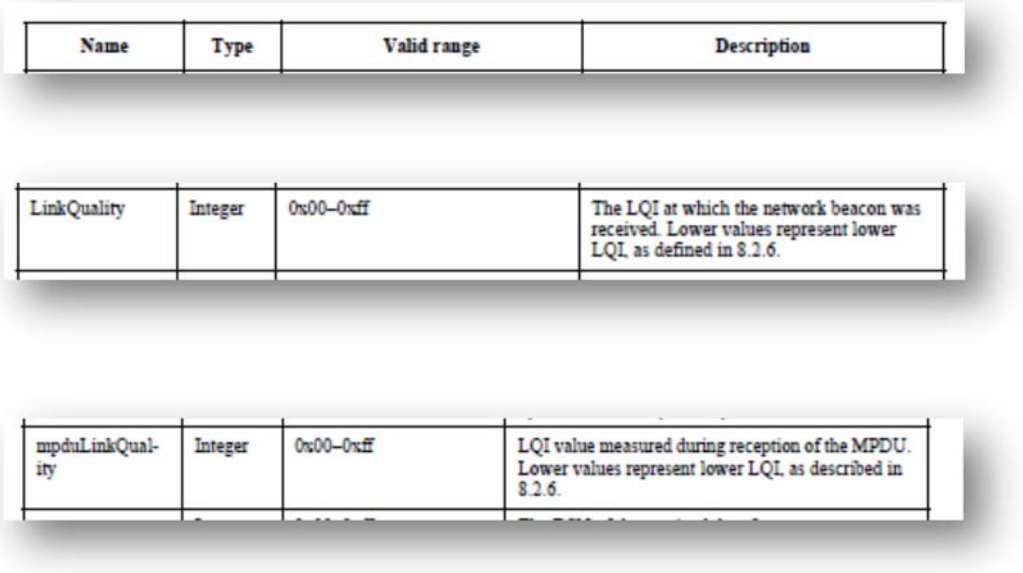
ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 321, Table 3.53.

8.2.5 Receiver ED

The receiver ED measurement is intended for use by a network layer as part of a channel selection algorithm. It is an estimate of the received signal power within the bandwidth of the channel

8.2.6 Link quality indicator (LQI)

The LQI measurement is a characterization of the strength and/or quality of a received packet. The measurement may be implemented using receiver ED a signal-to-noise ratio estimation, or a combination of these methods. The use of the LQI result by the network or application layers is not specified in this standard.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	The LQI measurement shall be performed for each received packet. IEEE Std 802.15.4-2011, at p. 153.  IEEE Std 802.15.4-2011, at p. 87, Table 17 and p. 122, Table 48. The link status command frame allows neighboring routers to communicate their incoming link costs to each other as described in section 3.6.3.4. Link status frames are transmitted as one-hop broadcasts without retries. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 283.

Name	Type	Valid range	Description
LinkQuality	Integer	0x00–0xff	The LQI at which the network beacon was received. Lower values represent lower LQI, as defined in 8.2.6.
mpduLinkQuality	Integer	0x00–0xff	LQI value measured during reception of the MPDU. Lower values represent lower LQI, as described in 8.2.6.

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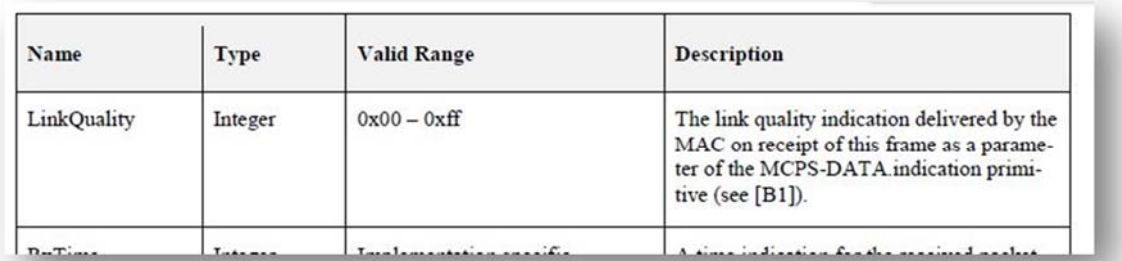
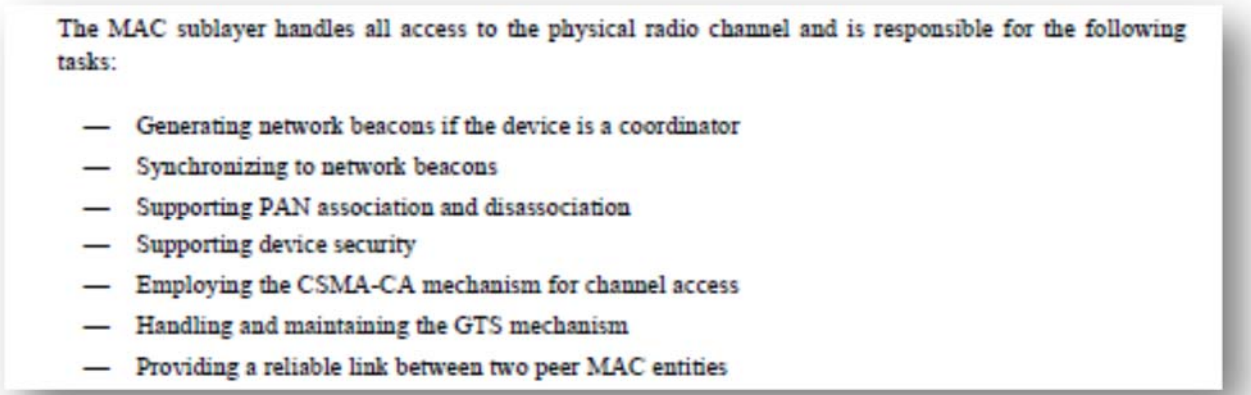
	Each link status entry contains the network address of a router neighbor, least significant octet first, followed by the link status octet. The incoming cost field contains the device's estimate of the link cost for the neighbor, which is a value between 1 and 7. The outgoing cost field contains the value of the outgoing cost field from the neighbor table. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 285. The neighbor table is useful in two contexts. First of all, it is used during network discovery or rejoining to store information about routers within RF reception range that may be candidate parents. Second, after the device has joined a network, it is used to ***store relationship and link-state information about neighboring devices*** in that network. A table entry shall be updated every time a device receives any frame from the corresponding neighbor. The ***outgoing cost field contains the cost of the link as measured by the neighbor***. The value is obtained from the most recent link status command frame received from the neighbor. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 319.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	 ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 227, Table 3.4 ("NLDE-DATA.indication Parameters"). *nwkReportConstantCost*…. If this is set to 0, the NWK layer shall calculate link cost from all neighbor nodes using the LQI values reported by the MAC layer ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 296, Table 3.49 ("NIB Attributes").
[c] scheduling demand assigned time slots for establishing additional communication links between the pairs of mobile nodes for transmitting the data based upon the link utilization metrics.	**Huawei Wi-Fi Products** *See* Claim elements 1[c] and 1[d] above. **Huawei Zigbee Products** The Huawei Zigbee Products further schedule demand assigned time slots for establishing additional communication links between the pairs of mobile nodes for transmitting the data based upon the link

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	utilization metrics. For example, and without limitation, the products schedule transmission of queued data during slots of the Contention Access Period of Superframes: *See* Claim element 25[a] above. > The features of the MAC sublayer are beacon management, ***channel access***, GTS management, frame validation, acknowledged frame delivery, association, and disassociation. IEEE Std 802.15.4-2011, at p. 11. > ***Any device wishing to communicate during the contention access period (CAP) between two beacons competes with other devices using a slotted CSMA-CA*** or ALOHA mechanism, as appropriate. For low-latency applications or applications requiring specific data bandwidth, the PAN coordinator dedicates portions of the active superframe to that application. These portions are called guaranteed time slots (GTSs). The GTSs form the contention-free period (CFP), which always appears at the end of the active superframe starting at a slot boundary immediately following the CAP, as shown in Figure 5. IEEE Std 802.15.4-2011, at p. 12.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	 The MAC sublayer handles all access to the physical radio channel and is responsible for the following tasks: — Generating network beacons if the device is a coordinator — Synchronizing to network beacons — Supporting PAN association and disassociation — Supporting device security — Employing the CSMA-CA mechanism for channel access — Handling and maintaining the GTS mechanism — Providing a reliable link between two peer MAC entities IEEE Std 802.15.4-2011, at p. 18. The CAP shall be at least aMinCAPLength, unless additional space is needed to temporarily accommodate the increase in the beacon frame length needed to perform GTS maintenance, as described in 5.2.2.1.3, and shall shrink or grow dynamically to accommodate the size of the CFP. IEEE Std 802.15.4-2011, at p. 19-20.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION

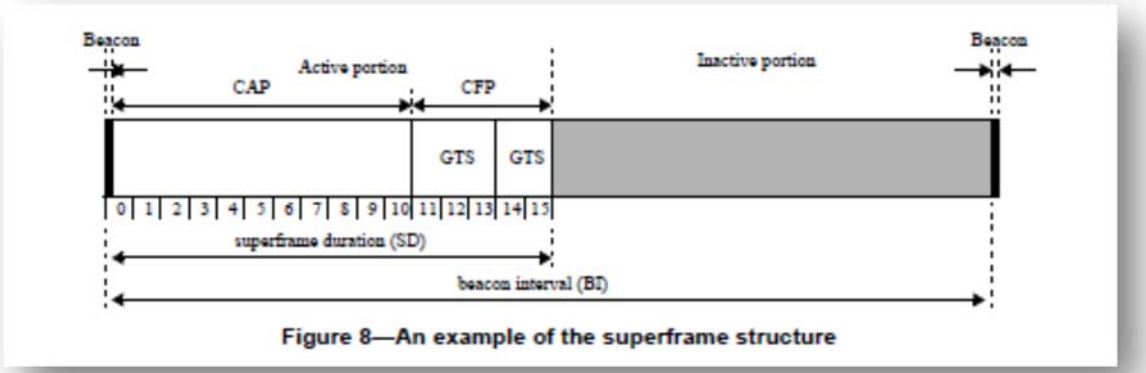


Figure 8—An example of the superframe structure

IEEE Std 802.15.4-2011, at p. 20, Figure 8.

> The ZigBee coordinator shall determine the beacon order and superframe order for every device in the network (see [B1] for more information on these attributes). Because one purpose of multi-hop beaconing networks is to allow routing nodes the opportunity to sleep in order to conserve power, the beacon order shall be set much larger than the superframe order. Setting the attributes in this manner makes it possible to schedule the active portion of the superframes of every device in any neighborhood such that they are non-overlapping in time. In other words, time is divided into approximately (*macBeaconInterval*/*macSuperframeDuration*) non-overlapping time slots, and the active portion of the superframe of every device in the network shall occupy one of these non-overlapping time slots.

ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 352.

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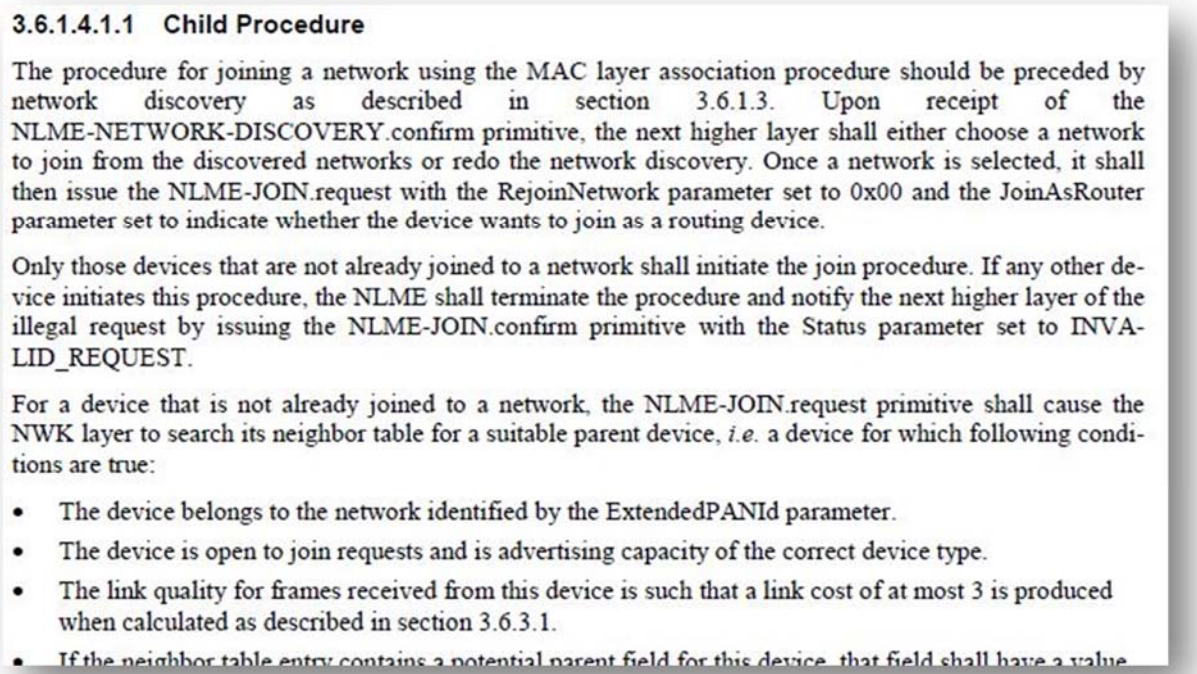
	Since every child tracks the beacon of its parent, transmissions from a parent to its child shall be completed using the indirect transmission technique. Transmissions from a child to its parent ***shall be completed during the CAP*** of the parent. Details for the communication procedures can be found in IEEE 802.15.4-2003 [B1]. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 353. A new device wishing to join the network shall follow the procedure outlined in section 3.6.1.4. In the process of joining the network, the new device shall ***build its neighbor table based on the information collected during the MAC scan procedure. Using this information, the new device shall choose an appropriate time for its beacon transmission and CAP (the active portion of its superframe structure)*** such that the active portion of its superframe structure does not overlap with that of any neighbor or of the parent of any neighbor. ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 353.

'986 PATENT CLAIM 25	INFRINGEMENT BY HUAWEI CORPORATION
	 **3.6.1.4.1.1 Child Procedure** The procedure for joining a network using the MAC layer association procedure should be preceded by network discovery as described in section 3.6.1.3. Upon receipt of the NLME-NETWORK-DISCOVERY.confirm primitive, the next higher layer shall either choose a network to join from the discovered networks or redo the network discovery. Once a network is selected, it shall then issue the NLME-JOIN.request with the RejoinNetwork parameter set to 0x00 and the JoinAsRouter parameter set to indicate whether the device wants to join as a routing device. Only those devices that are not already joined to a network shall initiate the join procedure. If any other device initiates this procedure, the NLME shall terminate the procedure and notify the next higher layer of the illegal request by issuing the NLME-JOIN.confirm primitive with the Status parameter set to INVALID_REQUEST. For a device that is not already joined to a network, the NLME-JOIN.request primitive shall cause the NWK layer to search its neighbor table for a suitable parent device, *i.e.* a device for which following conditions are true: • The device belongs to the network identified by the ExtendedPANId parameter. • The device is open to join requests and is advertising capacity of the correct device type. • The link quality for frames received from this device is such that a link cost of at most 3 is produced when calculated as described in section 3.6.3.1. • If the neighbor table entry contains a potential parent field for this device, that field shall have a value ZigBee Alliance, ZigBee Specification, Version r21 (Aug. 5, 2015), at 306 ("The link quality for frames received from this device is such that a link cost of at most 3 is produced when calculated as described in section 3.6.3.1.").